

Pacific Warmth Augurs Weird Weather

The central Pacific has spiked a fever in the last 4 months, hinting at the incipient arrival of El Niño—an ocean warming that upsets weather patterns in the United States and around the globe.

“We’ve been noticing ever since the end of last year that the waters have warmed rather rapidly throughout the central equatorial Pacific, as well as near the South American coast,” says Vernon Kousky of the National Oceanic and Atmospheric Administration (NOAA) in Camp Springs, Md. “At the same time, the low-level easterly winds have slacked off and become weaker than normal. Those are what we consider red flags that something is brewing out there.”

The Pacific has shown other signs of an impending El Niño. Thunderstorm activity has shifted recently from its normal position near Indonesia to the central part of the ocean, as it traditionally does during an El Niño. An atmospheric pressure pattern known as the Southern Oscillation Index has reversed in the last 2 months, another telltale sign.

These indications led NOAA to issue an advisory on May 9 saying that “we can expect warm episode [El Niño] conditions to intensify during the next several months.”

Climate researchers in the last decade have made great strides in forecasting El Niños, but their success rate is far from perfect. The recent warming, though dramatic, could fade quickly and never develop into a full-fledged El Niño.

Kousky and his colleagues issued the current warning in part because of forecasts from computer climate models run at the National Centers for Environmental Prediction in Camp Springs. For several months, their complex ocean-atmosphere model has been predicting a strong El Niño for later this year. A similar message has come out of the centers’ statistical model, a much simpler forecasting tool that relies on past weather patterns.

Other models have not been as bullish, though. An ocean-atmosphere computer model at the Lamont-Doherty Earth Observatory in Palisades, N.Y.—one of the premier forecasting models—has been calling for cool to normal conditions in the central equatorial Pacific, with only slight warming by year’s end.

“What gives us a little cause for concern was that some other models, as well as statistical techniques, did not indicate it. All techniques suffer at this time of year. It’s a tough time to make forecasts,” says Kousky.

Though the computers may be arguing,

human meteorologists sense El Niño’s presence. “We can see the whites of its eyes,” says Mary Voice of the Australian National Climate Centre in Melbourne. Her office of the Australian Bureau of Meteorology recently issued a forecast for warming in the Pacific. Such forecasts can help a wide variety of industries plan for the unusual weather that El Niño sparks.

El Niño is a natural climate phenomenon that develops when a pool of warmth normally located in the western equatorial Pacific spreads eastward toward the central part of the ocean. Wind shifts cause pronounced warming along the South American coast as well, traditionally peaking around Christmas-time, which led fishermen there to name the warming El Niño, a Spanish term referring to the infant Jesus.

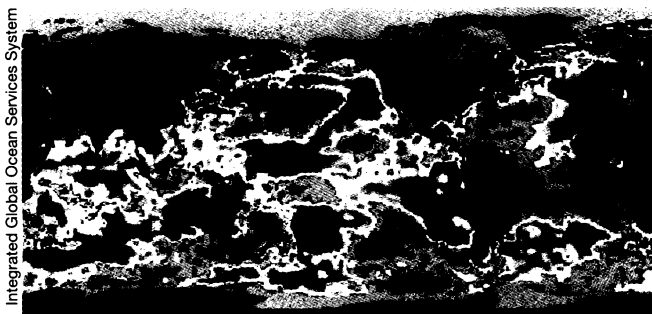
The Pacific warming redirects atmospheric wind patterns downstream and makes itself known around the world. Traditionally, it washes Texas and the Gulf Coast with extraordinary amounts of rain during winter, while western Canada and the northern United States

bask in abnormally warm winters. Sometimes, El Niño can bring heavy rains to California yet dry out the Pacific Northwest, says Kousky.

The Pacific warming often steals rain from Australia, Indonesia, parts of Brazil, and eastern and southern Africa. Conversely, it floods the normally dry west coast of South America.

If the current warming blossoms into a full-scale El Niño, it will perpetuate an unusual streak of warm years that has gripped the central Pacific since 1976. The cause of this trend remains uncertain, but some climate researchers interpret the enhanced frequency of El Niño events as a symptom of greenhouse gas pollution and global warming.

— R. Monastersky



A map of abnormal sea-surface temperatures in April shows strong warming (red and orange) in the central equatorial Pacific and off the west coast of South America.

Napless cats awaken interest in adenosine

Nearly 2 decades ago, scientists unearthed the biochemical explanation for why so many people crave a morning cup of coffee. Caffeine, the well-known stimulant in coffee, tea, and many sodas, revives people by preventing a compound called adenosine from binding to brain cells.

Since that discovery, adenosine has begun to intrigue more and more sleep investigators. Many studies in animals have shown that blocking adenosine’s actions in the brain increases alertness, while injections of adenosine or similar compounds induce apparently normal sleep.

Now, by monitoring the brain chemistry of cats, a team of researchers has shown that natural adenosine concentrations in at least some parts of the brain build up during waking periods and decline during sleep. Moreover, the investigators report in the May 23 SCIENCE, adenosine concentrations in the brain shoot up dramatically in animals forced to stay awake.

The findings offer the most compelling evidence yet that adenosine is one of the long-sought factors whose fluctuating concentrations in the brain determine when an animal must sleep.

“That’s fantastic. We predicted what they got,” says Miodrag Radulovacki of the University of Illinois College of Medicine in Chicago, the earliest champion of the adenosine theory of sleep.

The new adenosine research may bolster a recent theory that the body’s regular desire for sleep stems from the brain’s periodic need to replenish low stores of energy.

Adenosine is a relatively simple, nitrogen-containing compound used widely by the body. It forms the core of adenosine triphosphate, or ATP, the energy-storage molecule that powers most of the biochemical reactions inside cells.

In the brain, adenosine secretion by cells such as neurons and glia often reflects how busy the cells are. “Areas that are active generate adenosine; areas that aren’t active tend not to,” says

report coauthor Robert W. Greene of Harvard Medical School's Brockton (Mass.) Veterans Administration Medical Center.

This observation is central to a proposal put forth by H. Craig Heller of Stanford University and Joel H. Benington of St. Bonaventure University in Olean, N.Y. A few years ago, the pair pondered the mystery of why animals need to sleep. A host of theories, ranging from memory consolidation to aiding the immune system, have addressed this provocative issue.

Heller and Benington suggested that sleep occurs when some or all of an animal's brain becomes dangerously low on energy. Since the sleeping brain is much less active than the waking one, sleep allows the organ to replenish its energy, they proposed.

Adenosine could fit into this theory nicely, says Benington. Since adenosine secretion reflects brain cell activity, rising concentrations of this chemical may be how the organ gauges that it has been burning up its energy reserves and needs to shut down for a while.

To understand how adenosine induces sleep, Greene's team has studied the compound's effect on the brain's arousal centers. Cells in these centers have con-

nections throughout the brain, and they help keep a body awake and alert. Test-tube studies of the cells conducted several years ago showed that adenosine "can actually shut them off," says Greene.

From that work, Greene's group hypothesized that increasing concentrations of adenosine near arousal centers might compel an organism to sleep.

In the new study, the scientists anesthetized cats and implanted electrodes in several regions of the brain, including arousal centers, to monitor neuronal activity. They also inserted small probes to sample the extracellular fluid.

The researchers found that adenosine concentrations near an arousal center were higher when the cats were awake than when they were asleep.

The scientists then deprived the cats of sleep by constantly playing with them. After 6 hours or so of playing, the felines were exhausted. "At the end of the sleep-deprivation period, they just sit there and look at you trying to get their attention," says Tarja Porkka-Heiskanen, a study coauthor.

At that point, adenosine concentrations in the cats' brains were, on average, double those observed when the

cats had been awake for 2 hours. During 3 hours of "recovery" sleep, adenosine concentrations fell slowly.

Adenosine "is likely not the only sleep factor that exists in the brain. There may be others," notes Greene, adding that adenosine concentrations that normally induce sleep may be overcome sometimes by an excited or stressed animal.

Greene expects his group's work will stimulate renewed interest in adenosine, but he cautions against expecting a new sleeping pill soon. Even though the brain chemical induces a natural sleep that many current sleeping pills cannot duplicate, medicinal adenosine exerts several other effects. It can lower body temperature, alter blood pressure, and damage the heart.

The recognition of adenosine's importance in inducing sleep is gratifying, given that many scientists once discounted the connection, says Radulovacki.

The 64-year-old scientist notes that a friend recently asked him if he were happy that adenosine is now a hot topic. "I feel a lot better than when they ignored me. A scientist has to live long to reap the benefits," Radulovacki laughingly responded.

—J. Travis

T. rex bested by Argentinean beast

For generations of North American children, *Tyrannosaurus rex* has reigned as the most fearsome and favorite dinosaur, a tyrant unparalleled by carnivores on any other continent. Recent discoveries in Argentina have dethroned *T. rex* and raised up a new contender for the title of King Carnivore.

In Philadelphia last week, an audience of children gasped as paleontologists unveiled a 6-foot-long model skull showing *Giganotosaurus carolinii*, a dinosaur that surpassed *T. rex* in size.

Rodolfo A. Coria and his colleagues at the Carmen Funes Museum in Plaza Huincul, Argentina, first uncovered bones of *Giganotosaurus* in 1993 and estimated the dinosaur's length as 41 feet (SN: 9/23/95, p. 199). Last year, the researchers discovered many more bones of the skull, enabling them to reconstruct the animal's head more accurately. Coria now calculates that

Giganotosaurus reached 45 to 47 feet long and weighed 8 to 10 tons—making it 10 percent longer and a full 3 tons heavier than *T. rex*, says Coria.

"It is really very humbling, as a North American, to stand in front of this beast," says Peter Dodson of the University of Pennsylvania in Philadelphia.

There are even larger *Giganotosaurus* specimens waiting to be discovered, says Coria, who has found pieces of a second that is bigger than the original.

Another challenger for the King Carnivore title is an African theropod called *Carcharodontosaurus* (SN: 5/25/96, p. 335). Coria estimates that *Giganotosaurus* was larger than this African giant, which was a close relative.

Paul C. Sereno, a paleontologist at the University of Chicago who discovered a new specimen of *Carcharodontosaurus* in Morocco in 1995, debates that point. Sereno contends that it is difficult to tell

the size range of a species from just a few specimens. Moreover, there are not enough whole bones from the skull of *Giganotosaurus* to estimate even that specimen's length precisely.

All the paleontologists agree, however, that it is far more important to understand the animals' evolutionary history and their ecological roles



Reconstruction of *Giganotosaurus* skull. Human skull indicates relative size.

than to settle the size contest. Dodson notes that although these giant carnivores were similar in size, "the menu for each animal was very, very different."

T. rex, which lived 65 million years ago at the end of the Cretaceous period, fed on herbivores that were roughly its size or smaller. The 97-million-year-old *Giganotosaurus* dieted on herbivorous sauropods nearly twice its size.

T. rex's reputation endured further humiliation this week when researchers reported that the dinosaur suffered occasionally from gout. Bruce M. Rothschild of the Arthritis Center of Northeast Ohio in Youngstown and his team discovered sphere-shaped pits—telltale signs of the disease—in the hand bones of several *T. rex* specimens, they report in the May 22 *NATURE*. Gout is extremely painful and infrequently afflicts modern reptiles and birds, says Rothschild.

"Caricatures of the agony and ill temper of those afflicted with gout are magnified by its recognition in *T. rex*," the group notes.

—R. Monastersky



Artist's depiction of two *Giganotosaurus* on the prowl.